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Abstract

CONSTRUCTION OF THE CORE OF THE "HEAVY WATER-GAS" REACTOR EL 4

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The core of this reactor consists of a vessel containing heavy water, through which pass a sery of pressure tubes for circulation of the cooling gas under boat pressure.

The basic specifications which greatly influenced the design of this construction relate to aspects of safety in operation (fuel loading from both faces of the reactor, replacement of the components on both faces), neutronic demands (minimum absorption of the components lattice parameter, diameter of the pressure tubes) and thermal considerations (output temperature 500°C).

These specifications have led to a horizontal arrangement of the pressure tubes and raised very difficult problems of clearance, which make it impossible (for the dimensions of EL 4) to resort to expansion bellows on the pressure tubes. The result is a semi-rigid vessel in which the pressure tubes contribute to a large extent the mechanical resistance of the system by acting as a brace, whence the high stresses on the joints and pressure tubes (and the choice of zirconium alloys).

Translation provided by courtesy of the submitting Government

The construction components include the pressure tube, the joints, the thermal insulation and the liner tube. A brief account is given of the testing methods used and the performances of these various units is particular :

a) - the safety factors foreseen for the pressure tube, and the design and manufacture, taking account of tolerances, of the thickered ends necessary for fitting the tubes in place and designing the joints.

b) - the joints connecting the pressure tubes to the reactor tank, which are only accessible through the inside of the channel prolonging the pressure tube. These joints must not be a weak part in the construction. Two types have been developed : a rolled joint where the ends of the pressure tube are directly flanged onto the tank, and a welded joint using zircaloy-stainless steel transition pieces added to the ends of the pressure tube. All these joints are made by remote control and are removable.

c) - two solutions have been found to the problem of thermal insulation around a zirconium alloy liner tube. The neutron absorption equivalent is about 1,1 mm of Al, and the mean loss around 2 p. 100 of the thermal power of the reactor.

The methods proposed have proved practicable as a result of important research and developments on automatic remote control for all the operations which make up the sequences of mounting, demounting and reparing of the construction components. In particular the possibilities opened up by the new techniques of welding tubes from the inside have been extended to other problems connected with the assembling of a reactor.